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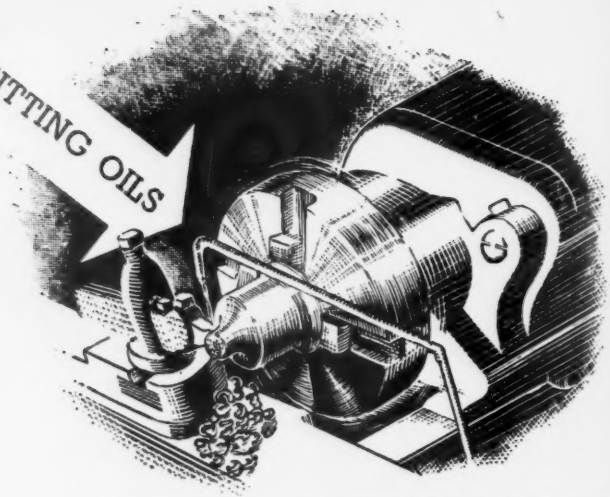

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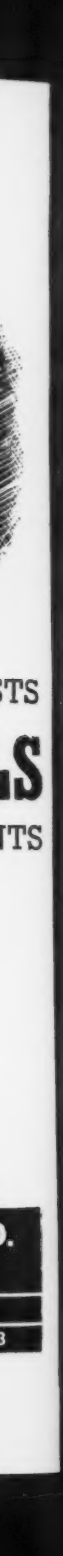

INSTITUTE OF PETROLEUM REVIEW

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THE SECOND OIL SHALE AND CANNEL COAL CONFERENCE

Since the first Oil Shale and Cannel Coal Conference was held in Glasgow in 1938, there has been much development in the winning and retorting of oil shale and in the manufacture and utilization of the products obtained from the shale oil.

During most of the intervening period there has been an embargo on the release of technical and operational details. Consequently, the announcement that the Institute of Petroleum was to hold the second conference between July 3 and 7, 1950, resulted in numerous enquiries for further information.

The Royal Technical College, Glasgow, was the venue of the second conference and registration day saw some 200 delegates from various countries gathering together. While the bulk of the delegates were from Great Britain, there were representatives from the United States, South Africa, France, Holland, Spain, Sweden, and Yugoslavia.

The choice of 1950 as the year of the conference had a significance in that it was the centenary year of the granting to Dr James Young of the patent which formed the basis of the oil shale industry. The celebration of this centenary was the first function of the conference and on the evening of July 3 the delegates gathered in the Examination Hall of the College to hear Dr William M. Cumming, O.B.E., former "Young" Professor of Technical Chemistry at the College, deliver the Young Centenary Lecture.

Following the reception by Sir Andrew McCance, chairman of the Board of Governors, who welcomed the delegates on behalf of the Board, Sir William Fraser, O.B.E., chairman of the Anglo-

D. Stewart (right) taking a party on the tour of inspection of the Westwood crude oil works.

Iranian Oil Co. Ltd., introduced Dr Cumming. At the conclusion of the lecture Mr C. A. P. Southwell, president of the Institute, thanked the lecturer for his interesting and comprehensive review of the work of James Young. He also expressed the thanks of all present for the hospitality they had enjoyed from the Governors of the Royal Technical College.

The Young Laboratory

At the conclusion of the lecture, the delegates adjourned to the new James Young Laboratories, which were formally opened by Sir William Fraser. The laboratories consist of a central hall around which are grouped offices, a workshop, and six research laboratories each suitable for two or three research workers. The use to which these laboratories will be put was explained by Professor P. Ritchie, the "Young" Professor of Technical Chemistry.

The Technical Sessions

The main business started in earnest on the morning of July 4, when at a short ceremony Mr C. A. P. Southwell formally opened the conference. He expressed a warm welcome to all delegates and in particular said how pleased they were to see the delegates of the U.S. Bureau of Mines—Mr E. D. Gardner, chief mining engineer, Mr R. A. Catlell, chief of the Petroleum and Natural Gas Branch, and Mr W. C. Schroeder, chief of the Office of Synthetic Hydrocarbons and Fuels. He also referred to the delegates from overseas and, after thanking the chairman and Governors of the College for their generosity in making the College available, declared the conference open.

During the two days of discussion, forty-eight papers were presented and discussed, eighteen in section A on Geology, Mining and Mineralogy and thirty in the section on Retorting, Refining, and Uses of By-Products. In all ten sessions were held, four in Section A and six in Section B.

In general, the discussion was intimate, lively, and friendly. In Section B in particular there was no lack of audiences and in some instances it was a case of "standing room only". Each paper was presented by its author or by his deputy and then discussed, and chairmen at times found it difficult to confine a session within its appointed limit.

It is of interest to note that 14 of the papers were from the U.K. (10 from Scotland and 4 from England), 11 from Australia, 8 from France, 7 from the U.S.A., 4 from South Africa, 3 from Sweden, and 1 from Holland.

At the Plenary Session which concluded the conference, Mr C. A. P. Southwell said that he had been impressed by the excellent organization of the conference. Its size had facilitated delegates in getting together to discuss their problems, and he paid a tribute to the work of the Scottish Branch of the Institute in making all the necessary arrangements.

In particular he referred to Mr R. Crichton, chairman of the Organizing Committee, and its secretary, Mr W. M. Stirling; to Dr W. M. Cumming and Prof. H. B. Nisbet, chairman and hon. secretary respectively of the Papers Committee, and to the chairman and reporters of the sessions; to the authors of the papers; to the Press officer, Dr W. Gibbs; and to the Ladies Committee.

This group at the Westwood works had a brisk pace set by D. MacDougal.

Only one resolution, other than a vote of thanks to all who had contributed to the success of the conference, was submitted. That was to the effect that the third conference should be held within a period of ten years. This was passed unanimously and the hope was expressed by Mr R. A. Cattell that it would be possible to hold it in the U.S.A.

Works Visits

On July 5 two works visits were arranged.

Over 70 delegates took advantage of the opportunity to visit the works of Scottish Oils Ltd. The first stop was made at Westwood, where the party split into two groups—one going underground to examine the winning of shale, while the others were taken round the retorts and crude shale oil works.

Then the party moved on to the refinery at Pumpherston, where they were first the guests of the company at a very excellent lunch. The visit to the refinery was again well arranged and each small group was accompanied by guides well-versed in the art of shale oil refining.

R. Crichton (right centre), *managing director of Scottish Oils Ltd. with C. A. P. Southwell, Mrs Crichton, and J. B. Simpson* (left), *watches the guests at Westwood, while J. M. Caldwell* (right) *passes on his way to ensure that all is well.*

At the luncheon, Mr R. Crichton, managing director of Scottish Oils Ltd., welcomed the delegates and expressed Sir William Fraser's regrets at not being able to be present. The industry was not looking back, he said. Since 1938 they had built the new works at Westwood, and had made considerable improvements in the methods of mining by the use of electricity

D. MacDougall and C. M. Cawley, both of the Fuel Research Station, with G. H. Smith of Scottish Oils Ltd. and J. Preston.

and by mechanization. The output per man was higher and they were refining by up-to-date methods and producing new products.

Mr R. A. Cattell expressed the thanks of the delegates for the hospitality and instruction they were receiving from Scottish Oils Ltd.

At the conclusion of the visit, the delegates were provided with tea, and it was agreed by all present that the day had been highly instructive and very enjoyable.

On the same day, a small party visited Ardeer, the principal factory of the Nobel Division of Imperial Chemical Industries Ltd. Here they were shown the various processes in the manufacture of modern explosives and detonators. They were also taken to the testing station, where various types of explosives and accessories were demonstrated including the use of power cartridges for various purposes.

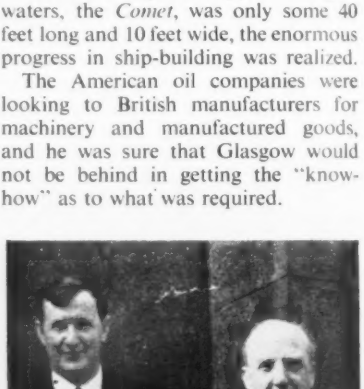
Dinner and Dance

The official dinner and dance of the congress was held at the Central Hotel on July 4 and was well attended and thoroughly enjoyed by all.

Proposing the toast of "The City of Glasgow" Mr C. A. P. Southwell said it was appropriate that they should have been able to pay a tribute to the pioneering work of James Young, not only in petroleum chemistry but also in his generous assistance and advice to the Royal Technical College.

Glasgow, as the second British city, was well known the world over for its variety of manufactures and interests, and on a recent journey on the *Queen Elizabeth* he had been filled with admiration for that ship. When it was recalled that the first steam-navigated ship, of Glasgow waters, the *Comet*, was only some 40 feet long and 10 feet wide, the enormous progress in ship-building was realized.

The American oil companies were looking to British manufacturers for machinery and manufactured goods, and he was sure that Glasgow would not be behind in getting the "know-how" as to what was required.



W. C. Schroeder (left) of the U.S. Bureau of Mines, and the President of the Institute look pleased with the results of the Conference.

On behalf of the delegates to the Conference and of the members of the Institute of Petroleum, Mr Southwell expressed their pleasure at being in Glasgow and asked them to drink to the prosperity of the City.

Another interested party en route to the crude oil works of Scottish Oils Ltd.

Acknowledging the toast, Baillie T. R. Patterson, J.P., senior magistrate of the City of Glasgow, welcomed the delegates and expressed the regret of the Lord Provost that he was not able to be present. He wished the Conference every success and, although he pleaded some ignorance of the oil industry, said he knew how important oil shale had become for those who lived in Scotland and how great had been the progress in that industry in recent years. The memory of James Young would be preserved in Glasgow, concluded Mr Patterson.

The toast of "The Institute of Petroleum" was proposed by Mr E. D. Gardner, chief mining engineer of the U.S. Bureau of Mines. He said that he was a mining engineer, but oil shale made a good bridge between mining and drilling for oil. Consequently he was rapidly becoming oil minded. He had nothing but praise for the Institute of Petroleum and was impressed by its members being concerned in all phases of oil from the geological and exploitation stage to its final application in use. In conclusion he praised the Institute for arranging the Conference and expressed the hope that the time would come when such a meeting could be held in the U.S.A., when he hoped the world-wide interest would be maintained.

In reply, Col. S. J. M. Auld, O.B.E., M.C., past-president of the Institute, said that the Institute was primarily a professional body and its natural bias was, therefore, towards that side. Its bright young men were most often the budding engineers and physicists, the geologists and chemists, but he was sure that the business cadets and the graduates of the schools of economics would find it worth while to have a section of the Institute of their own. There was a place for *all* oil men in the Institute of Petroleum.

In conclusion, he left with his hearers the thought that the help given to the Institute by the oil companies and by associated industries would be well repaid and that the continued broadening of the basis of the Institute might be the most suitable way of doing it.

At the conclusion of the speeches, dancing was the order of the evening and the delegates and their ladies occupied the dance floor until "Auld Lang Syne" concluded the procedings at midnight.

The Civic Reception

The last formal function of the Conference was on the evening of July 6, when the Corporation of the City of Glasgow entertained the delegates and their ladies at a Civic Reception at the City Chambers.

Guests were first received by the Lord Provost, Mr Victor D. Warren, M.B.E., C.St.J., T.D., and magistrates in the

R. A. Cattell (left), of the U.S. Bureau of Mines, discusses a problem with some of the French delegates.

Satinwood Room. They then proceeded to the Banqueting Hall, where the Lord Provost welcomed them, saying that the conference had returned to Glasgow after a considerable interval. The prime reason for the choice of Glasgow was Dr Young. He himself had known about Dr Young at a very early age, as he and his father were then engaged in an industry dependent upon paraffin wax.

As Lord Provost, he was delighted that Glasgow had been chosen. He hoped that their deliberations had been successful and that the ladies had found much to please them.

Mr C. A. P. Southwell, thanking the Lord Provostand the Corporation for their hospitality, said it was a great privilege for the delegates to be in the hall of that great city as guests.

The Conference had been a complete success, with delegates from many countries, and they had been able to see the Scottish shale industry at work. There they had seen something most encouraging in the very excellent relationships which existed between management and workers.

Mr Robert Crichton, chairman of the Organizing Committee of the Conference, also expressed the thanks of all concerned for the welcome extended to them.

Following this there was dancing in the Banqueting Hall and simultaneously a concert of vocal music in the Council Hall.

Excursions

Splendid arrangements were made to ensure that the ladies were not left without entertainment during the time when the delegates were occupied with the more formal business.

Thus, on the Tuesday, the ladies had the opportunity of seeing some beautiful Scottish scenery on a tour which took them through Crieff, Comrie, St. Fillans, Lochearnhead, Callander, and Aberfoyle.

On the Wednesday, a visit to Edinburgh, with time for a shopping expedition and visits to the Castle, Holyrood Palace, and the King's Park, was arranged. Thursday was the occasion for a visit to the birthplace of Robert Burns at Alloway, the route being via

"Discussion Groups" at Aberfoyle on the Visit to Scotlands beautiful Trossachs.

(Photographs by George Sell.)

Strathaven and Mauchline, returning via Ayr, Largs, Gourock, and Greenock.

From all accounts it seems certain that the ladies, particularly those from overseas, thoroughly enjoyed the opportunities which these tours offered.

On the Friday, with the technical sessions behind them, the delegates joined the ladies on what proved to be a delightful trip to the famous Trossachs. The route followed was via the Blane Valley, Aberfoyle, the Trossachs, Loch Katrine, to Callander, where a halt was made for lunch. Then, on through Stirling and Linlithgow to the Forth Bridge, with a slight detour from the pre-arranged path to enable a view of the refinery at Grangemouth to be obtained. From the Forth Bridge, the party proceeded to Edinburgh, where an extended tea interval allowed the men-folk also to see some of the attractions of that city, and then on to Glasgow.

At Glasgow, delegates were deposited at various centres, and on each occasion there was much vigorous hand-shaking between those who had made acquaintance with each other during the Conference.

The general opinion expressed during and after the Conference was that it had been a very happy gathering and that, from the technical viewpoint, the opportunities for discussion, both formal and informal, had been a particularly valuable feature.

★ ★ ★

Report on Petroleum. Under this title the Association of Scientific Workers, 15, Half Moon Street, London, W.1, have published, price 6d, a survey made by their petroleum sub-committee. The survey gives a graph of crude oil output from 1880 to the present day, deals briefly with refinery operations and with products, and includes a chapter setting out suggestions for a petroleum policy for Britain.

BRITISH STEEL FOR CANADIAN OIL

Orders have recently been placed by the Anglo-American Oil Co. Ltd., acting on behalf of Imperial Oil Ltd., Canada for British steel valued at more than £400,000.

These orders are for some 80 miles of $10\frac{3}{4}$-inch steel pipe, 55,000 feet of $8\frac{5}{8}$-inch seamless pipe, and 300,000 feet of 7-inch casing.

The pipe will be used to link the city of Winnipeg, Manitoba, with the main oil pipeline, now being built by the Inter Provincial Pipe Line Co., which runs seventy-five miles south of the city, between the new oilfields of Alberta and the Great Lakes. The total cost of this important branch line will be in the region in one million pounds sterling, and the initial oil throughput to Winnipeg will be almost half a million Imp. gallons a day, although the line will be able to handle almost three times that amount with the aid of additional pumping equipment. Completion of the project is expected at the latest by the spring of next year.

ANALYSIS AND TESTING MEETINGS IN PARIS

An international conference on analysis and testing, on the lines of those that took place prior to 1939, has been organized by the Société de Chimie Industrielle and will take place in Paris from November 20-24. Papers for presentation are divided into five groups—laboratory apparatus; physico-chemical techniques; analysis of mineral products; organic chemical analysis; and biochemical analysis.

Papers, which if not in French should preferably be in English, though other languages are acceptable, should be submitted to the Society at 28, Rue Saint-Dominique, Paris 7., by October 15.

THE ROLE OF THE PROCESS ENGINEER IN THE PETROLEUM REFINERY*

By C. C. WUTH

The technological and engineering problems encountered as routine in the design and operation of a present-day petroleum refinery are so complex and varied that it is easy to lose sight of the fundamental bases from which the modern plants are developed. New processes and new processing techniques are constantly being devised by the chemists and technologists, new feed stocks become available for processing, economic structures change, and demands for new products arise or are created. Although decisions necessitated by any of these causes are finally made by management, often using the reports of specialists in the several fields concerned as their guiding data, most large refiners have placed the responsibility for presenting co-ordinated proposals affecting their plant operations in the hands of the process engineer.

At present process design and process operation courses are included generally in chemical engineering curricula, but there still is no distinct branch of the engineering profession known as process engineering. Accordingly, the process engineer must be defined by the duties which he discharges and by the range of his activities.

If the general definition of a process is accepted as a means by which the physical or chemical state of some material is altered according to plan, the less simple task of defining an engineer may be attempted, admitting that the answer depends materially on the point of view of the person propounding the definition. It is axiomatic to state that the process engineer, along with all who profess to be engineers of any kind, must be a well-rounded individual. He must be practical, to the point where he views with suspicion all abstractions and unproved theories. He must be realistic, because of the responsibilities involved by the acceptance of his decisions. Although this realism leads naturally to a deep conservatism, the process engineer particularly, among all the accepted fields, is continually confronted with new problems and must be unceasing in his search for a new and better means for solving them. Further, he must be a master of compromise, as his work is almost entirely a succession of economic and technical choices to meet requirements that usually are mutually inconsistent. Finally, it must be recognized that in the petroleum refinery, as well as throughout the entire group of industries of which processing is a basic part, all processes are utilized in order to increase the value of some material, usually a crude feed stock or by-product stream that otherwise would be lost or disposed of without profit. From this standpoint it will be recognized that an economic awareness is the essential requisite of our definitive process engineer.

As a more specific requirement, the process engineer knows the process flow of the various refinery operations, he knows the mechanics of plant necessary to provide the flow scheme, he is able to calculate profitabilities for the operations, and he is able to choose between alternative operating plans, some of which may involve new and costly equipment while others may be cheaper in execution but less efficient.

*An address to the Stanlow Branch of the Institute of Petroleum on March 15, 1950.

The man who is able to fulfil these duties is generally either a mechanical engineer who happens to have a leaning toward problems involving chemical processes or, a chemical engineer with more than the ordinary interest in mechanical equipment. As a seasoned engineer, he also has a working knowledge of metallurgy to guide in his choice of materials of construction, as well as a reasonable familiarity with civil and electrical engineering problems and their more usual solutions.

Although it may seem that the definition which is developing outlines an ideal type of person, not to be encountered casually on an industrial payroll, it must be remembered that only a few years ago the ordinary oil refinery engineer was a pioneering jack-of-all-trades. Often one or two engineers would handle all the technical tasks in connexion with the design of a new unit, or even of an entire refinery. Possessed of an exceptionally broad knowledge and practical experience in many branches of engineering, but necessarily limited in each, these resourceful pioneers performed for the oil industry in its earlier days substantially the same vital service that the "horse-and-buggy" doctor gave us before the general acceptance of the medical specialists. It is possible to carry the analogy still further: just as there is still a place for the family doctor and the general practitioner, so is there a need for the refinery process engineer to assure that the refinery and its component units are operating efficiently and profitably.

Process Flow Diagrams

A very few years ago the term process engineer was applied to the man responsible for the process flow in any refinery operation. Accordingly, the process flow diagram was his basic means for developing and presenting the results of his work. The development of flow diagrams parallels closely the development of process engineering and the range of a process engineer's duties may be expressed in terms of the types of flow diagrams which we encounter in petroleum refining problems and which comprise, in effect, the tools of his profession.

The simplest flow diagram is the type called a "box" or "block diagram", on which the steps through which materials are handled are each shown by a simple rectangle. In this way the basic concept of an integrated refinery may first be laid out. For example, crude storage capacity may be shown in one box with a single line connecting to a box representing a simple topping plant and suitable interconnexions shown to treating units, rundown tankage, and product distribution outlets. The type of process engineer ordinarily dealing with this simple "box diagram" is the person responsible for overall flow studies which lead to economic evaluations of refinery operating procedures. Changes in sales values, offtake requirements, or product specifications may necessitate operating changes. Similarly a change in crude feed composition may vary the offtake rates for products. Any of these changes may best be studied in a preliminary way by means of this simple chart.

The process engineer dealing with this simplest type of flow diagram ordinarily operates out of the research and development section of a refinery, or in his own process engineering department with the larger companies. His tasks are of the utmost importance to every company. The quality of his work, the accuracy of his data, and the soundness of his interpretations determine to a large degree the profitability of a refinery's operations. During the last war the process engineers in the United States were responsible for the discovery and utilization of an almost unbelievable elasticity in pre-war refinery plant which permitted expansion of output far beyond rated capacities. Similarly, the new plants which were built so rapidly

from standardized designs to meet wartime needs were operated in conjunction with old facilities under extreme ranges of operating conditions to deliver the unprecedented demands.

In order to formulate detailed operating design data, the refinery process engineer must know the potentialities not only of each plant in the refinery but also must be aware of the operating capacities and limitations of each piece of equipment within any one plant. This requirement leads logically to development of the plant process flow diagram. In the simplified flow chart for any process, the normal fractionating and processing equipment will be indicated, together with pumps, heat transfer apparatus and major instrumentation, but the various by-passes, sample connexions, and operating conveniences need not be shown. This process flow diagram permits the engineer to study the effects of operating changes on an overall plant heat transfer programme and also facilitates estimation of throughput limitations in various sections of the plant.

The final complex flow diagrams from which construction drawings are prepared also may be developed by the process engineer, although this is the province of the specialist rather than the refinery man. It is quite usual for complete flow diagrams to be presented on sheets 15 or 20 feet in length or covering as many as six or eight standard size drawings. While the refinery process engineer must have a complete familiarity with the construction flow diagrams, they are sufficiently specialized to lie outside his normal scope of assignments.

Plant Re-vamping

When it becomes necessary to revise or remodel existing plant or add new units, the work of the process engineer is especially appreciated. While it is possible for all of the required functions to be performed by technologists and plant engineers, the number of choices available regarding the method in which capital expenditures are to be made is so large in many instances that reasonably complete economic studies must be developed for each alternative before operating profitabilities may be calculated. It then becomes necessary for the process engineer to make a preliminary plant flow layout for each case, size each major item of equipment roughly, and prepare approximate estimates of capital and operating costs. His working knowledge of the components of a process plant then becomes invaluable.

The most common process is, of course, fractional distillation. It is not necessary to repeat the history of the development of the present day fractionating column from the original batch shell stills used in the early days of petroleum refining. The modern column is a well-standardized piece of equipment and every process engineer is able to make a reasonable estimate of the number of plates required for any particular separation problem and if necessary is able to calculate actual theoretical requirements. However, in the development of a number of optional plans, it may be necessary to consider 10 or 20 or more fractionating columns and to estimate the approximate cost of each. The process engineer, knowing the product recoveries and degrees of separation needed, is able to make a rough estimate of the plate requirements and follow immediately with a calculation of shell thickness, a generalized construction material specification, and thus arrive at a rough cost figure sufficiently accurate for preliminary economic studies. After a final design is agreed, the actual construction data for fractionating columns which are to be built, or the new operating conditions for existing equipment under consideration, heretofore have been calculated by the specialists ordinarily available for these studies. As a matter of interest, a calculating machine to

supplant the tedious "trial-and-error" methods that have been necessary for designing and pre-determining the performance of fractionating columns is now promised. The *Petroleum Refiner* for February 1950 describes "an automatic 'thinking' device which can figure out the performance of a multi-component fractionating towers in a fraction of the usual time." The machine has been described by its inventors as "an 'analogue computor', composed primarily of resistors, potentiometers and amplifiers, suitably chosen and connected to yield the electrical representation of equations, though in slightly modified form. A 400-cycle carrier voltage is applied to a number of channels; one channel is required for each chemical component to be represented and while six are provided in the present machine, this is not a basic design restriction. Each channel is composed of a number of circuits, along which the voltage is multiplied by the appropriate factors. At various locations, voltage signals are added and subtracted as required by the plate-to-plate equations. The machine can be employed not only on the design of new equipment, but also on the study of possible design and feed variations which might be made in existing fractionation columns."

Heat Balancing

Another major aspect of the process engineer's duties involves the supply and removal of heat in the various process stages. The economics of present-day refineries, where the total fuel burned may be equivalent to between 10 and 20 per cent of the crude oil intake, are dependent to a large extent on the range and efficiency of the heat exchange programme. It is a long way from the early refineries in which all heat was supplied by furnaces and all condensing and cooling was done in submerged pipe coils. It was common practice at that time to assume an overall heat transfer coefficient of "3" for heat transfer apparatus and for the engineer to take credit for any throughput increases above the design figure. In designing condensers or coolers for the present-day refinery, a process engineer must choose between the same submerged pipe sections, which are still used occasionally, and many other types of equipment. Although the conventional tube and shell heat exchanger is installed in a large majority of cases, extended-surface elements comprising a finned-tube within a plain-bore tube have wide application where high pressure differentials obtain or where special metallurgical problems may arise.

The process engineer must develop his heat transfer programme to deliver all products at suitable handling temperatures, while considering the rate-of-return of the capital expenditure required for each piece of heat transfer equipment proposed for installation. This type of overall study covers the water cooling system as well, including the cooling tower if needed and it presents opportunities for savings which did not exist a few years ago. An example of a particular type of heat transfer programme showing imaginative treatment is in operation in the western part of the United States where a gasoline plant was built with a cooling water system sufficient only to cater for a control house and laboratory air conditioning unit. In this particular case, product rundown streams are cooled by incoming feed and all condensing and high-level cooling duties are accomplished in forced-draft air-cooled extended-surface equipment known commercially as "fin-fan" units. The low cost of fuel gas for heating and driving the fans more than offsets the high cost of water, which must be brought to the site in tank cars.

Fluid Flow

A third phase of process design includes problems involving fluid flow and transfer of liquids and gases between

various operating systems. These may usually be solved by the accepted hydraulic formulæ and by reference to pump and compressor characteristic curves and operating specifications. In some cases, particularly those involving multi-stage centrifugal compressors, the operating limitations of the machine may become important to process considerations. Again this may be considered in the line of problems which may be assigned to specialists and need not be developed in detail by the process engineer.

Instrumentation

The fourth, and most important class of processing apparatus from the engineer's standpoint, covers measurement and control of process variables, more often called simply "instrumentation". If a single generalization may be permitted regarding the desirable characteristics for the definitive process engineer, it is that he should be an instrument mechanic at heart. This implies what may be called "gadget-mindedness", because nowhere else in the field of present-day industry has the effect of ingenious mechanical and electronic devices been so important.

Starting with the simple flowmeter, thermometer, and pressure gauge, the range of refinery instrumentation has expanded so rapidly and so diversely that this is one phase of refinery operations where nothing may be classed as impossible. Recording of product quality data has become commonplace. Not only are there continuous records of pertinent gas analysis data, but it is possible to bring A.S.T.M. distillation results, fuel calorific values, and product viscosities to the plant operator's notice without the delays inherent in the usual routine of sending samples to a central control laboratory and awaiting test results. Pneumatic transmission and electrical relays have obviated the necessity for bringing high pressure piping into the modern control room and the present trends in control room design now indicate obsolescence in the near future for the magnificent rows of recorders and controllers which make such an impressive picture in refinery control houses.

One type of control panel gradually coming into general use has been developed most obviously by process engineers. In a number of recent plants a complete operating flow diagram of the plant under control has been reproduced in large scale on the main control panel and small indicating dials have been installed to show important flow, pressure, temperature, and fluid level conditions. Primary measuring elements located throughout the plant transmit their readings to the panel dials and the operator is able to re-position the control points from the panel knobs. With continuous indication of operating variables clearly shown in this manner, the overall condition of the plant may be appraised from minute-to-minute by the operator-in-charge. Records of the various temperatures and pressures which may be necessary to detect maloperation or valuable to permit analysis of long-term changes are printed in groups of six or eight on strip-chart instruments; flow readings needed for accounting purposes may be recorded as necessary, but as these data are not neeeded for routine operation of the unit, there is no need to complicate the plant operator's job by mounting the instruments directly in his control area as has customarily been done in the past.

A second variation on the method of controlling complicated operating units is being developed in the form of "console control". With this type of instrumentation, all the important operating variables for one plant or even several interdependent units are indicated on miniature dials grouped before the operator in-charge at a centrally located desk. Controller settings may be adjusted from small knobs or keys

available at his fingertips. In this way, one operator may view as many as 100 or more instruments simultaneously. By the judicious use of alarm lights to indicate abnormal conditions or trends, it is possible for him to have a continuous concept of plant operation with considerably less mental strain than that imposed, for instance, on the pilot of a present-day commercial aircraft who is responsible for a like number of gauges as a secondary consideration to actually flying his 'plane. With this design of control, as with the flow diagram panel layout, recording instruments may be located in an entirely separate room if desired, so that the control room of the future may well become in fact the plant operator's office.

Through the continuous efforts of the process engineer, advantage will be taken of improved instrumentation to provide some of the greatest opportunities for further economies, not only through savings in manpower, but through increased efficiency. It is an accepted fact that the present-day controller may truly be termed "anticipatory", because compensating control action is taken in hand by the control mechanism as soon as the recorder pen or indicator pointer begin to show any change from desired conditions as transmitted from the primary element. On almost any instrumentation job involving heat input or removal, the simplest fully-compensated controller, properly installed, will outperform the most experienced operator's hand control, using the output temperature record as a basis for comparison. The complete steadiness of such process control increases efficiencies of separations and recoveries to a large degree, and further opportunities are surmised for labour savings beyond those now considered practicable. At the annual instrumentation symposium conducted at Texas A. & M. College in October 1949, G. W. McCullough, vice-president of Phillips Chemical Company, stated: "The day should not be too far distant when computor control panels are an everyday installation. A plant operator will turn one or two knobs to a final quality desired and the instruments assembled with the panel will make the adjustments for temperature, pressure, etc." He went on to say that "the next few years should see an increasing number of manual controls delegated to instruments. This will reduce the human element in operations, increase efficiency of the process, and allow the operator more time for other duties." If the idea of computor controls resetting plant instruments through electronic relays seems fantastic at this stage, we should consider the complex mechanisms used for gunfire control aboard modern warships. It is well known that it is possible to sight and fire anti-aircraft guns by means of radar interceptor apparatus, meanwhile compensating automatically for wind and motion of the vessel. While it is granted that such controls were developed under stress of wartime necessities, the potentialities of devices of equivalent complexity may be readily grasped.

Basic Equipment

The four basic processing equipment classifications which are encountered in petroleum refineries are, therefore: (1) fractionating columns, (2) heat transfer apparatus, (3) fluid handling systems, and (4) measurement and control. There are, of course, an infinite number of flow arrangements in which various combinations of these components may be connected. The scope of the process engineer's interests may be outlined by a brief résumé of the most important of these arrangements.

Of all the processes with which the engineer deals, the basic one comprises distillation in one form or another. Plant design requirements may be met in a simple batch still, which is no more than a large teakettle, or it may be necessary to provide "super-fractiona-

tors" which use as many as 60 or 80 trays with high reflux rates and comprehensive controls. Almost all refinery plants utilize fractional distillation in one form or another, either as an integral part of a separation process or in a secondary manner, as when treated products are re-run for removal of polymers or impurities. The primary process, therefore, regardless of what crude oil is being supplied or which type of product is required, is fractional distillation. This may be carried out under relatively high pressures or, in some cases where elevated temperature may be a disadvantage, under high vacuum.

Secondary processes depend upon the range and type of products required for sale or further processing. If gasoline is primarily required, the secondary processes may include cracking, either thermal or catalytic, reforming, and the various methods for removing sulphur or sweetening gasoline for sale. A group of processes which may be considered in the tertiary class will include olefin polymerization, alkylation, hydrogenation, and isomerization, all of which are employed in various ways for the production of high octane components.

For production of lubricating oils, various solvent extraction processes may be employed, as well as any number of treating and filtration processes which have been developed to provide high viscosity-index lubricants having appearance designed to give good sales-appeal value.

As an example of how the process engineer functions, the actual steps involved in modernization of a refinery where a process engineer is responsible for project development may be reviewed. The first step will be preparation of the "box diagram" with existing plant and flow rates of the various projects shown in their appropriate places. A comparable diagram will then be prepared for the desired conditions. Required quantities and comparative qualities of intermediate streams and plant products then may be studied and a rough determination made as to the limitations of existing plant. The process engineer, knowing the potential bottlenecks within each operating unit may analyse his proposed new data and decide where revisions will suffice to meet the new conditions or whether an entire new unit must be provided. If a choice is permissible, the capital and operating cost estimates for each alternative must be prepared so that a profitability may be computed for any necessary expenditure. After the final process flow diagrams for each step have been developed, as described earlier, the work of calculating equipment and pipeline sizes may be turned over to the appropriate specialists. The process engineer will then proceed with a layout of unit plot plans to ensure that the arrangement is efficient and provides optimum operator convenience. The drawing office may then begin development of necessary foundation and building details, the electrical engineers may plan power and lighting requirements, and all other detailed work may proceed toward installation of the new project in the field.

As soon as basic design data are developed the process engineer ordinarily will calculate alternative operations, should revised offtakes become necessary or desirable. By these means, the operating flexibility of any unit may be predicted in advance of operation and the plant operator may adjust conditions within these design limitations to assure maximum efficiency and minimum loss of valuable plant products.

After work in the field has been completed and the unit is ready for start-up, the process engineer may assist in operation through the initial stages. Despite long experience and the most complete basic data, actual operation of plant seldom follows the predicted

pattern in every detail. Fortunately the design safety factors which the process engineer provides usually permit good operation at throughput rates at least slightly in excess of those anticipated. However, process plants invariably seem to develop a "personality" of their own and some operating variables for which expensive control mechanisms have been provided will be found to possess absolute stability. Other conditions which were expected to be smooth in operation may require automatic control. The flexibility of modern control apparatus usually permits "second-guessing" with respect to instrumentation by the process engineer. Control points and locations of measuring elements may be shifted to give the smooth control originally intended, so that it is to be expected that well-ordered operation will be attained after a relatively short onstream period.

In order to be completely candid, it must be stated that the process engineer rarely has the satisfaction of following through all the foregoing stages in the sequence outlined. Before any unit is operated, it seems inevitable that management or the technologists will request a complete revision of operating conditions. Even if these turn out to be within the limitations of plant operation, it is safe to say that no more than three or four months will elapse before new operating requirements are set forth. The process engineer's routine then begins another cycle involving his "new" plant, which now has become an "old" plant to be studied, modified, or even dismantled, if economic study indicates that a profitability will be realized from such drastic measures.

Training

In conclusion it must be recognized, that there is no training ground for process engineers other than the actual petroleum refineries. Presumably there are scientific methods for personnel selection which will indicate in the early stages of training those young engineers who have a tendency toward the qualities required for this class of engineering. Until these methods are developed and generally accepted, it appears probable that replacements and additions to the ranks of process engineering will come mostly from the young chemical engineers who are being developed by our colleges and universities. Those men showing particular aptitude for process design problems should receive some operating experience and then serve a period in the refinery engineering department. The young engineer may then decide that the satisfaction of dealing with the constantly changing and essentially vital problems of refinery operations will appeal particularly to him. Without this incentive, process engineering usually will not prove sufficiently attractive, as compared to the more usual refinery careers which lead to plant operation or maintenance engineering, and where the opportunities for advancement into management may seem brighter.

The competition for promising men which construction contractors offer is perhaps an even more serious factor in the manpower problem. Although there may be less job stability in employment with a construction contractor, the immediate rewards are admittedly greater and most of the smaller refiners, as well as several of the larger companies, regularly employ the process engineering departments of construction contractors to solve their problems in the manner which has been outlined.

Regardless of the ultimate organization which various companies have developed or may propose, it appears almost certain that the position of principal adviser to management with regard to operational economics may best be filled by the type of person whose activities, achievements, and usefulness have been described and who chooses to call himself a "Process Engineer".

RETIREMENT OF W. A. WOODROW

At the end of July, W. A. Woodrow retired after forty years in the petroleum industry. Except for short periods with Palmer's Candle Works and the Ragosine Oil Co. most of his career has been spent with the Anglo-American Oil Co. Ltd., whose service he entered in 1911 as a chemist at Purfleet.

During the first war he served first with the Seaforth Highlanders and later with the Special Brigade, Royal Engineers (Chemists' Companies). Returning to Purfleet early in 1919 he was soon promoted to second-in-charge and a year later assumed complete control.

Mr Woodrow remained at Purfleet until 1929, when he was transferred to the Vauxhall laboratories. On the outbreak of the second war he was seconded to the Petroleum Board as chemist-in-charge of the laboratories at Vauxhall.

In the Institute, of which he was elected a Member in 1922 and a Fellow in 1939, W. A. Woodrow has been a very active worker in the sphere of standardization. Here his wide knowledge of petroleum analysis and testing has been a considerable asset, and he has served on many committees and panels of the Standardization Committee. He became a Fellow of the Royal Institute of Chemistry in 1937, having been elected to the Associateship in 1926.

During his service with Anglo-American Mr Woodrow made many friends, and on the day of his retirement a "family" gathering was held by his colleagues in the Technical Sales Department. A bottle of wine was broached to toast his future and, as is customary with all such functions in that Department a "token" presentation was made of articles closely allied with his work. The first was a very large antiquated American railway signal lamp, suitably labelled, to remind him of his work on the burning test, a box of colour tubes and a pair of smoked glasses for his work on the colour, and a small toy garden mower, the force of this last joke being known only to a few of his immediate friends.

Later, in the presence of H. C. Tett, general sales manager, R. A. Hyslop, assistant general sales manager, C. Chilvers and T. C. G. Thorpe, past managers of the Department, K. C. Hunt, present manager, and many of his friends from other departments of the company, Mr Woodrow was presented with gifts of his own choice. These were a portable typewriter, a water softener, and an electric iron, from which it will be seen that he had unselfishly chosen gifts for his home as well as for himself.

After reminiscent speeches the party concluded with expressions of good wishes to Mr Woodrow for many years of happy retirement.

Mr Woodrow tells us that his plans for his retirement are not yet formulated but we feel sure that he will not have any difficulty in filling his time. We wish him a happy retirement.

PERSONAL NOTES

We regret to record the death at his home at Packanack Lake, N.J., of **A. L. Beall**, F.Inst.Pet., assistant to the chief engineer of Wright Aeronautical Corp. An internationally-known authority on aircraft fuels and lubricants, Mr Beall had served with Vacuum Oil Co. before joining Wright in 1933.

T. G. Crane has been appointed deputy managing director of Monsanto Chemicals (Australia) Ltd. He joined Monsanto nearly 18 years ago as assistant plant chemist in the rubber section at Ruabon. For some time he has been manager of the Technical Sales Department.

THE CONTRACT WATCHMAN

By A. F. DABELL (Fellow)

It was in Baku, in the days of the Czar, that we employed one Mussa, a local Tatar who, for appropriate consideration undertook to watch and guard our oil-plots and compensate us for all loss sustained by theft.

He did little actual watching or guarding, relying for immunity upon his local reputation for private direct action with evil-doers who defied his authority, or those whom he considered had done so—a technique appearing to carry equal deterrent effect.

Compensation for occasional loss he invariably made in kind—with full measure—generally to the discomfiture of another producer in the same district who lacked his protecting influence.

Upon one occasion he tendered some 50 feet of 12-inch camel hair belting to replace 45 feet of 10-inch stolen from us.

Upon its rejection he persisted in argument that on his part he was fulfilling the terms of his contract—in our favour.

Mussa also acted as personal guard to our cashier on pay days. He sat beside him from the bank to the field in a horse drawn carriage, surrounded by mounted Cossacks.

During the pay-out he was at his back with a long-barrelled revolver in hand.

Prevailing conditions, incidentally, prompted our covering our cashier in his private capacity, employing only *artelskeeks*, that is men belonging to a guild which undertook to cover defalcation on the part of its corporate members.

The attributes of Mussa upon an occasion unique, served us to good purpose—good by oilfield moral standards of that period.

It arose in this way. Our head bookkeeper, who hailed from the birth place of Stalin, a district noted for its hill scenery, beautiful women, lavish hospitality, and men of above average academic education, expert in murder and blackmail, almost whispered in my ear that he had discovered that no rent for the past ten years had been paid to the Municipal Authority for a disused pipeline we owned running under and along the main street of Black Town.

He showed that through cumulative charges arising from penalizing clauses applied to payments in arrear, a liability —on our part—had accrued and amounted to a sum approaching the equivalent of the nominal capital of my company.

His advice—in response to my appeal was "Do nothing!" But after a night of thought I felt that our salvation might lie in the removal of the incriminating evidence—the pipeline. Before however, we could do so it would be necessary to apply for official authority to trench the main street—a petition for which would assuredly expose our default.

Further meditation prompted recourse to Mussa, to whom I gave a plan of the route of the line and a hint that it was his for the lifting. A smile of fraternal nature was the response.

I had an idea that baskets of fresh fruit found at my door thereafter were associated with this transaction and, no call for rental being made, I asked how the venture had prospered.

He said he had recovered every joint of pipe and that he had gained exemption from the customary formalities by personal attendance.

He trusted the blessing of Allah would rest upon me and that I had enjoyed the fruit.

Note. In Baku there was no equivalent of the Marine Store Dealer Act. Vict. Op., etc. and "Old metal" merchants flourished. Any requisite would be "supplied" by them at short notice.

THE 1950-51 SESSION

An interesting series of papers has been arranged for presentation at the Ordinary General Meetings of the Institute during the coming session.

Three of the meetings will be devoted to products, the session being opened on September 13 with a paper on carbon black manufacture by L. W. Cabot, J. W. Edminster and C. A. Stokes. On November 8, Dr W. W. Myddleton has promised to speak on the subject of petroleum in toilet preparations and cosmetics, and will discuss such items as the desirable characteristics of oils for these purposes and the methods of examining them. Later in the session—on February 14—T. C. G. Thorpe will read a paper on petroleum waxes with particular reference to their use in packaging.

At our second meeting (October 11) the part played and being played by petroleum in European recovery will be discussed by Vernon Smith.

Work which the Institute is carrying out will be discussed at three meetings, when members will hear of the progress made in a wide range of subjects. Thus, selected items in the work of the Standardization Committee will be the subject of the meeting on April 11, while on December 6 the Spectroscopic Panel of the Hydrocarbon Research Groups will give a series of papers on the spectroscopic methods they are investigating. The Engineering Committee has already produced a code of electrical practice and is working on three safety codes to be applied in the production, the refining and marketing branches of the industry. These codes will be discussed on January 10.

The Papers Sub-Committee has always considerable difficulty in inducing the exploration or production branches of the industry to present their problems for discussion or their achievements for approbation. However, S. G. Van Hoogstratten has promised to say something about the use of diesel engines in oilfield work on March 7.

For the last meeting of the session an interesting symposium on combustion reactions in relation to gas turbine practice is being arranged for May 9 but it is not yet possible to announce exact titles of papers or names of authors.

Members and visitors, who are always welcome at the meetings, are asked to note that it has not been possible to hold every meeting on the second Wednesday in the month. Thus, December and March meetings are both a week earlier than usual.

Stanlow Branch

Stanlow Branch are to open their Session on October 19 with an address by the President—C. A. P. Southwell, M.C.—on the planning of a large scale crude oil development in a desert region. This end of petroleum industry will also be discussed on March 21, when Prof. Frank Morton will talk on the origin and migration of petroleum.

A symposium on apparatus will form the subject of a joint meeting with the Royal Institute of Chemistry on December 20, with papers by Dr J. W. Drinkwater, R. C. Robson, A. J. Davies and J. C. E. Button, while on February 14 C. D. Brewer and B. H. Thorp will present a paper on the influence of fuel characteristics on the behaviour in C.I. engines.

At the Annual General Meeting of the Branch on January 17 there will be an address by M. A. L. Banks, a vice-president of the Institute, on refinery considerations, and on November 15, L. W. Cabot, J. W. Edminster and C. A. Stokes will repeat the paper which they are reading to the Institute in London in September.

A precedent is being created on November 26 (Sunday) when a scientific film show is being held.

CALCULATING PETROLEUM RESERVES A DISCUSSION

By G. M. LEES

In my article in the *I.P. Review* of February 1950 I commented on an estimate of possible world reserves by A. I. Levorsen contained in a paper to the United Nations Conservation of Resources Conference held in September 1949. My comments have brought a rejoinder from my old friend Wallace E. Pratt published in the *I.P. Review* of June and also a personal letter from Levorsen both objecting strongly to my point of view.

The difference between us concerns the potential oil richness of the continental shelves of the world, and I must apologize for having made a bald statement in the postscript to my previous article without expanding sufficiently the geological argument on which it was based. Levorsen had estimated the total possible world reserves to be 1500 billion barrels (or 200,000 million tons) but of this total two thirds were attributed by him to the continental shelves based on a calculation by Wallace Pratt of the cubic volume of the sediments on the continental shelves throughout the world and ascribing about the same productivity per unit volume to these sediments as experience has indicated to be the case on land in the U.S.A.

An estimate for the amount of sediments deposited on the continental shelves throughout the world is particularly hazardous, involving as it does a number of important assumptions on the geological history of the border zone between continents and oceans. There are advocates of continental drift whereby the continents as we now know them drifted apart from a single ur-continent through a treacly sub-stratum to their present positions; there are believers in permanent oceans requiring little change in the major outlines of the continents throughout the whole of geological time; and there are people like myself who believe that the present distribution of land and sea bears little resemblance to what it has been in earlier geological time. I believe, for instance, that the major zones of compression of the earth's crust, where they strike out into the oceans at the continental margins, do not end abruptly, but continue under the ocean floor. Many examples might be quoted—the Appalachian system striking north-east into the Atlantic at Newfoundland, the Moroccan Atlas zone striking westward into the Atlantic, the Caledonian system crossing from Ireland through Scotland into Norway and so into the Arctic ocean, New Zealand being a visible sector of a fold system continuous through New Guinea and the Dutch East Indies, etc., etc.

It follows from my general tectonic conception that the continental shelves of the world are only the seaward extension of the continents and no generalization is possible on their value as oil reserves. Each sector requires individual appraisal depending on the structural character of its adjacent land and on the probable date of its submergence. Thus Hudson Bay has, I imagine, greatly inferior oil prospects to the Gulf of Mexico, the Red Sea is surely less attractive than the Persian Gulf, and the Java Sea is preferable to the Gulf of Carpentaria.

Twenhofel (quoted by Levorsen) estimated the average thickness of sediments on the continental shelves of the world to be about two miles. It may be so if metamorphosed sediments are included, but my contention is that a calculation of world reserves on such an insecure basis is quite unjustified. I have not attempted to make an alternative estimate and I hope that I shall

not be provoked into doing so. But I am willing to challenge Levorsen that he cannot sell his ideas to any oil company to induce them to drill a well in the Hudson Bay.

★ ★ ★

80 MILE WATER LINE FOR VENEZUELA REFINERIES

To provide fresh water for personnel and operations at the Shell and Creole Petroleum Co.'s refineries on the arid Paraguana Peninsula of Northern Venezuela, an 80-mile long pipeline has been constructed from the Siburna Springs, a natural water supply, in the San Luis foothills on the mainland.

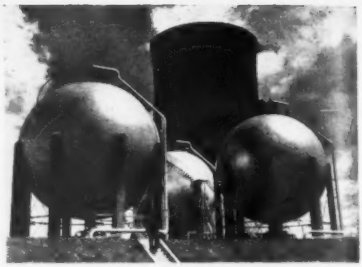
The pipeline, the building of which was arranged jointly by the two oil companies in association with the Venezuelan Government, is 34 inches in diameter at its origin, narrowing to 30 inches for its major portion. It is laid on top of the ground, and operates by gravity, since the difference in elevation at origin and termini is some 800 ft. As a measure against corrosion, the inside of the multiple-jointed steel pipe has been given a complete coating of pipeline enamel.

"MODERN APPLICATIONS OF LIQUID FUELS"

Two years ago the Institute of Fuel and the Institute of Petroleum organized a Conference in Birmingham on Modern Applications of Liquid Fuels. The proceedings of that Conference are now available in book form complete with illustrations and a report of the discussion.

There are nineteen papers in the 500 pages of the book and they cover all aspects of the efficient use of liquid fuel in the heavy industries, for railway traction, for agricultural drying, for gas-making, and in the home.

Price is £1 1s and the supply is limited.



"Ball" banks at Stanlow: For the storage of butane under pressure, three large spherical tanks, 35 ft in diameter, have been installed at the new Shell refinery at Stanlow.
(Shell Photographic Unit).

CANADIAN OIL COMPANIES

The *Financial Post* "Survey of Oils," the 1950 edition of which has recently been published, gives some valuable data on oil companies in Canada. Details of the organization, property, development, and finance of some 500 to 600 companies are incorporated in its 224 pages, and statistics of the industry are included. Maps of the principal Alberta fields are shown.

Copies are obtainable from Maclean Hunter Ltd., 2 Cockspur Street, London, W.C.2 (price 6s. 6d.) or from Maclean Hunter Publishing Co. Ltd., in North America (price $1).

GIANT VACUUM FLASHER

A vacuum flashing unit, said to be the world's largest, and capable of charging 55,000 brl day of reduced crude, is to be built at the Richmond refinery of Standard Oil of California by the M. W. Kellogg Co.

The new unit is being designed to provide approximately 30,000 brl of feed per day for the cracking unit at Richmond, which is currently being modernized. As well as charging reduced crude, the unit will also process some heavy, "non-refinable" crudes.

STEAM TURBINE LUBRICATION*

By W. E. J. BROOM and G. H. CLARK†

In Britain, industrial and domestic demands for electricity have, mainly due to the impetus of the war, outstripped generating capacity and it says much for the design and reliability of British power station equipment that so few major breakdowns of electrical supply have occurred considering that the majority of stations are seriously overloaded. The increase in supply and demand for electric power is illustrated in Fig. 1.

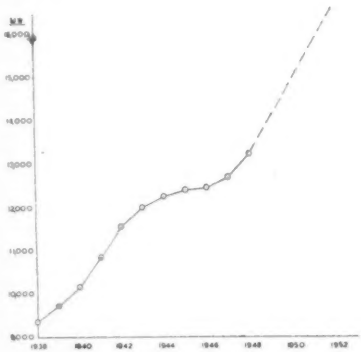


Fig. 1.

Installed and projected generating capacity in Great Britain.

The output of modern turbines has greatly increased over the past few years and 160,000 kW from one machine is no longer a rarity, particularly in the U.S.A. where, due to many large plants working continuously on the shift system, it is economical to run base load stations. Generally speaking due to our different industrial economy, base load stations are not so suitable in Great Britain. With a heavy daytime industrial and domestic load and relatively light loads at night, power stations have to be much more flexible in operation and for this reason there are few sets in operation exceeding 90,000 kW while the majority of stations operate 30,000 or 60,000 kW alternators.

At the same time as the size of the units increased, so did steam pressures and temperatures, so that turbines taking steam at 1600 p.s.i. and 900° F are not uncommon.

It was decided in the United Kingdom in view of the urgent need for new power stations, to standardize for the next few years on units of 30,000 and 60,000 kW capacity with maximum steam pressures of 900 lb and temperatures of 925° F. Of equal importance in view of the fuel situation, is the need for greater efficiencies in both boiler and generating plant and a major step forward was taken with the introduction of hydrogen-cooled alternators.

The more exacting conditions under which modern turbines operate have necessitated the development of new turbine oils and lubrication is now almost a minor function of the oil; 90 per cent of the oil passing through a bearing is used as a coolant, with 10 per cent acting as the lubricant. In addition, the oil is used as a hydraulic medium to operate governor gear and nozzle valves, and in hydrogen-cooled units as a sealing medium to prevent leakage of hydrogen.

Lubrication systems in modern high-temperature high-pressure turbines, are extremely complicated as can be seen

* Paper read to the Northern Branch of the Institute on October 18, 1949.

† Anglo-American Oil Co. Ltd.

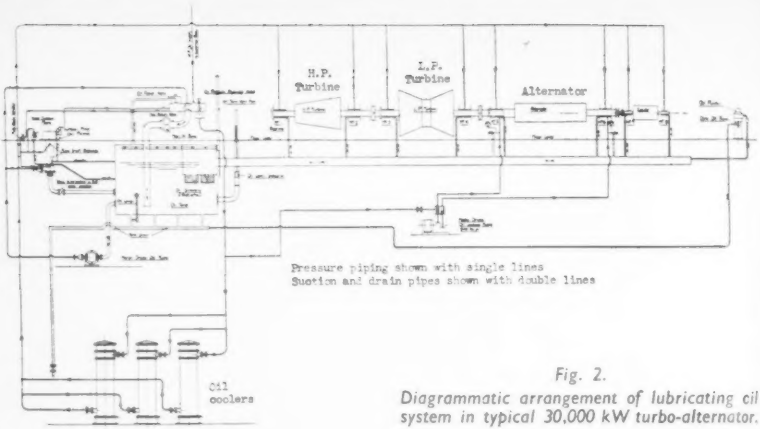


Fig. 2.
Diagrammatic arrangement of lubricating oil system in typical 30,000 kW turbo-alternator.

n Fig. 2 which illustrates diagrammatically the lubricating oil system of a modern 30,000 kW turbo-alternator.

Lubrication Systems

A serious problem with modern units is the risk of fire caused by oil pipe breakage or leaks spraying the lubricating oil on to hot external parts of the machine. A fine leak might remain undetected for some time allowing insulation on steam pipes or turbine casing to become saturated with oil; if a fire breaks out under such circumstances it can become serious.

This hazard has been fully recognized by many manufacturers and various methods are employed to reduce the risk to a minimum. High-pressure lubricating oil pipes are kept as far as possible from hot steam lines, valves and casings. Certain manufacturers employ the double pipe method in which the high-pressure pipes are contained inside the return pipes, while others place as much of the oil piping as possible within the bearing pedestals and oil reservoir. Bolted flange joints are in some instances being replaced by welded joints.

It is evident that the manufacturer is placing considerable faith in the quality of the lubricant as it is virtually impossible to remove sludge or other deposits from the cored passages without immense trouble and cost.

Oil Reservoirs

In old turbines it was almost universal practice to place the oil reservoir in the box-shaped cast iron foundation of the front bearing pedestal or possibly of the turbine itself. Access to these tanks for inspection and cleaning purposes was most difficult and strengthening ribs supporting the top caused eddy currents in the oil and acted as traps for water and deposits. In addition, the amount of oil in circulation was limited, resulting in some cases in high oil-operating temperatures despite the fact that the heat conducted along the rotor spindle to the bearing journal was very much less than in modern practice. Porous castings often caused unsightly leakage of turbine oil besides presenting a fire hazard.

Many of these machines are still in use.

The majority of large modern turbines are fitted with large-capacity fabricated steel tanks usually placed in

an accessible position below the machine. An improved design is to construct the tank with a sloping bottom so that water and solids drain to the lower end. The centrifuge suction is taken from the lower end and, in addition, a direct drain may be fitted through which the water or solids which have settled out can be readily removed, thus reducing the work of the centrifuge or filter.

One leading manufacturer has for some years, used a hopper-bottomed reservoir in which the centrifuge suction is some distance from the bottom of the tank, in which a direct drain is located. In all cases the main lubricating oil pump suction should be placed well above the bottom of the tank, if possible in the area of least turbulence.

Oil returns from bearings should be kept as far away as possible from the pump suction to allow undesirable solids and water to settle out, but of course they must be kept well below the minimum oil level to minimize foaming.

Perhaps the ideal type of tank is the tall narrow type with sloping bottom, with the minimum oil surface exposed to air, and a reduced amount of metal exposed above the oil level. Rusting is thus reduced and oxidation of the oil less likely. Another advantage is that water and solids precipitate more readily as there is less oil agitation.

Oil Pumps

The main lube oil pump is driven from the turbine spindle by means of worm or spur gears and is usually of the double gear wheel type. It may be mounted on the front bearing pedestal with a suction pipe to the main oil reservoir, or it may be located in the tank itself and driven by an extended spindle from the gears on the turbine spindle. The pumps are of the positive displacement type and of robust construction. Delivery pressures are usually in the region of 50-60 p.s.i., and they discharge through a spring-loaded relief valve which ensures a steady oil pressure to the governor control gear. This high pressure supply to the governor bypasses the oil coolers. Oil supply to the bearings is taken from the outlet side of the relief valve and led through a reducing valve where the pressure is reduced to about 15 p.s.i. The oil then passes through the oil coolers to the bearings.

The auxiliary oil pump, used to supply oil to the governor and bearings for emergency use, is usually mounted directly on top of the oil reservoir. It may be motor or turbine driven having both manual and automatic controls. The manual control is used to start and stop the pump when the turbine is being started or stopped, while the automatic control starts the pump when the oil pressure in the system falls below a pre-determined figure, usually about 40 p.s.i. This ensures that there shall be no interruption of oil supply while the machine is running.

In addition, several turbine builders incorporate a small high-pressure jacking pump which is used to lift the alternator and turbine rotors hydraulically, prior to engaging the barring gear. This ensures that there will be no metal-to-metal contact between journals and bearings, greatly reducing static friction and bearing wear. As the turbine provides probably the best example of fluid film lubrication when operating at full speed, practically all bearing wear takes place when starting or stopping the machine.

Oil Coolers

Oil coolers of the surface cooling type with water circulating through the tubes and oil on the outside, are universally fitted to modern turbines. Although these coolers are most efficient, in some cases too little consideration is given to suitable positioning in relation to the lubricating oil system, of which they are an integral part. They are frequently located in a horizontal position in part of the turbine room

basement, where they cannot be readily opened up for cleaning. or may be found below the lowest point in the lubrication system, thus providing a natural trap for deposits. The most suitable location is in a vertical position at least on a level with the oil reservoir and not below it.

It is general practice to maintain the oil pressure in the cooler at a higher pressure than the circulating water to ensure that in the event of a tube failure there will be no ingress of possibly contaminated water into the oil system, although an oil loss must be accepted until the leakage is detected and rectified. When starting the turbine, however, many operators commence water circulating the cooler before the auxiliary oil pump builds up the oil pressure and similarly stop the auxiliary pump when shutting down before shutting off the circulating water. Under these conditions it is possible that contaminated water can enter the oil system. This is particularly undesirable when the power station is situated on a tidal waterway, as salt water leaking into the oil stabilizes emulsions and, what is perhaps even more serious, causes serious corrosion to delicate parts of the governor and to the turbine journals.

Certain American builders are now locating the oil coolers inside the oil reservoir (Fig. 3). The coolant used is condensate from the extraction pump discharge, and it is claimed that average temperature rises of from 10° to 15°F in the feed water give a considerable saving in the boiler fuel costs. In this case the water pressure is always maintained at a higher pressure than the oil to prevent any risk of oil getting into the boilers. Access to the tube stack for cleaning is, of course, possible without draining the oil system.

Fig. 3.

Interior of oil reservoir of large American turbo-alternator. Vertical oil coolers can be seen in the background. Note also welded oil pipes.

Oil Piping

Solid drawn steel piping is almost universally used in modern units to reduce to a minimum the risk of a burst pipe. Copper pipes have been eliminated mainly due to the high catalytic action on the lubricating oil. Bolted or welded joints must be capable of withstanding high pressures with hot oil. Sharp bends in the pipes are undesirable as they cause excessive oil turbulence. Returns from bearings should have a gentle fall; horizontal lengths of piping and dips are undesirable on the grounds that the oil velocity is low and any solids in the oil are deposited in the pipes instead of returning to the oil reservoir where they can be removed. On the other hand, too abrupt falls in the return lines cause excessive turbulence and foaming in the oil reservoir. In all cases oil returns should be led well below the oil level. If it is found impossible to avoid vertical pipe drops into the reservoir, suitably placed baffles greatly reduce the risk of foaming. In all cases the returns should be as far removed as possible from the oil pump suction.

Adequate ventilation of oil reservoirs is very desirable, as this removes much of the water vapour and any harmful acidic vapours such as may be developed with an oxidized oil.

Fig. 3 illustrates a good example of welded pipe construction but it should be noted that the relief valve escape is

just about at oil level, which is an undesirable feature. Certain oil pipes were disconnected when this photograph was taken.

Hydrogen-Cooled Alternators

It is hardly within the scope of this paper to discuss the design and advantages of hydrogen-cooled alternators, but perhaps it would not be out of place briefly to cover the main points.

Advantages: (1) The density of pure hydrogen is one-fourteenth that of air, so that windage losses are greatly reduced, resulting in a gain in efficiency in large sets of up to 1½ per cent. Noise is also reduced.

(2) The specific heat of hydrogen is about fourteen times that of air and its heat transfer coefficient is 50 per cent greater than that of air. As the thermal conductivity is also about seven times that of air, these factors combine to give a much lower temperature rise in an alternator, or enable a greater output to be attained from the same machine. Insulation life is also longer, due to almost complete elimination of corona. Certain American manufacturers claim that an increase in output of more than 20 per cent can be attained when using hydrogen as the alternator cooling medium.

Disadvantages: (1) As the hydrogen is under pressure, in some cases up to 15 p.s.i., heavier gas-tight casings are required (Fig. 4).

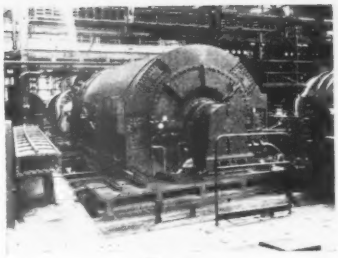


Fig. 4.
Hydrogen-cooled alternator on test bed.

(2) Elaborate sealing glands and additional lubricating oil equipment are required.

(3) Hydrogen-air mixtures in certain proportions are highly explosive and air must be eliminated as far as possible.

(4) A fairly complicated gas control system must be installed.

The main interest from the oil point of view is that turbine oil is used in specially designed glands to prevent gas leakage. These sealing devices fall into two main categories. Fig. 5 shows the ring type of seal consisting of two brass or gunmetal rings, made in halves for assembly, with a check to prevent rotation, with a clearance between shaft

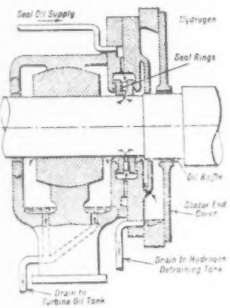


Fig. 5.
Floating ring type of gas seal for hydrogen-loaded alternator.

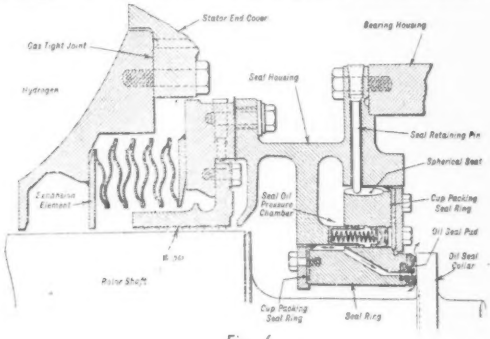


Fig. 6.
Thrust type gas seal for hydrogen-cooled alternator.
(Courtesy *The Engineer*)

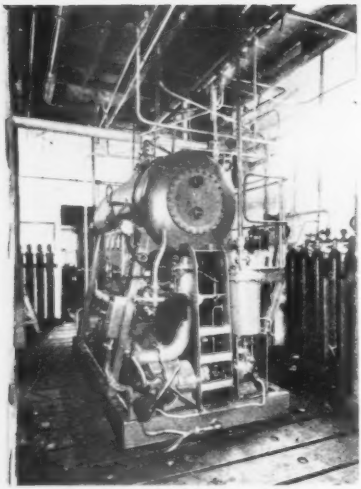


Fig. 7.

Complete hydrogen detraining and gas servicing equipment for hydrogen-cooled alternator.

(Courtesy Metropolitan-Vickers Electrical Co. Ltd.)

and seal of approximately 0.004 in. An oil film between the fixed and moving members forms the actual seal. Oil is pumped into the seal continuously and maintained at a pressure of approximately 10 p.s.i. above the gas pressure. The oil is supplied at $\frac{1}{2}$ gal/min to an annulus at the centre of the ring and flows in both directions through the small clearance. Oil baffles on the alternator side serve to prevent oil entering the casing.

Fig. 6 illustrates the thrust type of seal in which a white metal faced ring bears against a collar on the shaft. The ring or runner is held against the collar by means of a spring and by oil pressure. Oil at a pressure of 5 to 10 p.s.i. is fed to a small annular groove in the white metal face, the greater part of the oil flowing radially outwards between the face and the collar where it escapes and is returned to the adjacent journal bearing drain. A small amount of oil flows radially inwards towards the hydrogen side and this oil supply actually forms the seal. This type of seal is much more complicated than the ring type, but it is claimed that as there is a much reduced flow of oil to the hydrogen side there is much less absorption of hydrogen, and therefore high vacuum equipment for detraining the gas from the oil is unnecessary. At present, however, manufacturers fitting this type of seal in the U.K. are using vacuum equipment until more operating experience is gained.

Fig. 7 shows a complete hydrogen detraining unit with associated pumps.

Turbine oil in the main oil system may have absorbed up to 5 per cent of air by volume and if untreated oil comes in contact with hydrogen, the gas displaces some of the air, and the purity of the hydrogen inside the casings gradually falls. It is therefore obvious that the oil should be as air-free as possible. In addition oil escaping on the inside of the seals absorbs a certain amount of hydrogen, which is a little more soluble than air.

The usual system employs an oil pump which supplies oil to the seals, the actual oil used being taken from the main oil system. The oil pump is usually duplicated, the standby being driven by a D.C. motor from the station battery. Drains from the air side of the seals return to a seal oil reservoir. Drains from the hydrogen side containing hydrogen foam readily and they are therefore led to a defoaming tank where the oil settles, releasing a considerable amount of the gas which is returned to the alternator casing. Both tanks are connected to a vacuum tank from which the circulating pump takes its suction. The greater part of the pump discharge returns through sprays to the top of the vacuum tank while the remainder passes through an oil cooler to the seals. The oil sprays present a large area of oil and the entrained gas bubbles expand under the reduced pressure and separate from the oil.

The vacuum pump taking suction from the top of the vacuum tank removes hydrogen and any air present, and vents it outside the building. A drain on the bottom of the tank enables any water present to be drained to bilge. Make-up from the main oil system maintains a constant level of oil in the seal oil system.

Although temperatures are low in the seal oil system and hydrogen itself has no deleterious effect on the turbine oil, it is advisable that the turbine oil used is of the highest quality and maintained in good condition for the following reasons:

(1) *A clean oil contains less entrained air and moisture than an oxidized oil;*

(2) *If an unsuitable oil is exposed to high vacuum, light ends will vaporize and be removed, raising the viscosity of the remainder;*

(3) *Sludge or solid matter in an oxidized oil will tend to build up on the seals thereby impairing their efficiency and resulting in gas leakage.*

To be concluded

ESSO EXPORT CORPORATION

George M. Parker

Esso Export Corporation is to establish headquarters in London to co-ordinate the refinery production of all Standard Oil Co. (New Jersey) affiliates in Western Europe and to adjust balance of market requirements.

George M. Parker has been elected vice-president and will be in charge of the London office. In the past he has been advisor to Jersey Standard on market operations in Latin America, the U.K., Europe, N. Africa, and the Near East.

Franklin Rowley has been elected a director of Esso Export, and his duties will include co-ordination of purchases of materials abroad. Since 1940 he has been assistant general purchasing agent of Esso Standard Oil Co.

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"VERENA" LAUNCHED

S.T.S. *Verena*, second of Shell's new fleet of four 28,000 d.w.ton tankers, was launched on June 29 at Belfast by Lady Slessor, wife of Marshal of the R.A.F. Sir John Slessor. The first of this fleet of tankers, S.T.S. *Velutina*, was launched by H.R.H. Princess Margaret last spring (*I.P. Review*, May 1950) and the third, the *Volsella* took the water on July 4 from Birkenhead.

Fitting out is proceeding in these three tankers and it is expected that the *Velutina* will soon make her maiden voyage to the Persian Gulf under the command of Captain W. Shaw, O.B.E.

Each tanker of this fleet will be capable of making eight round trips a year from the Persian Gulf, carrying to Britain an annual total of 200,000 tons of crude oil.

S.T.S. Verena

GAS TURBINE TECHNOLOGY COURSES

A programme of courses from October 1950, until June 1951 is announced by the School of Gas Turbine Technology, Farnborough Place, Farnborough, Hants. Courses are short but intensified and may be classified under the following headings: Industrial gas turbines (three weeks); Aero engines (two weeks); Practical and installation (two weeks); International (three weeks). The first two categories are open to British students only. Fees are fifteen guineas a week for tuition, plus £3 10s a week for accommodation. Applications should be addressed to the Principal at the School.

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U.K. PETROLEUM CONSUMPTION

In reply to a written question in the House of Commons on July 27, the Financial Secretary to the Treasury said the quantities of hydrocarbon oils retained for home consumption in the U.K. during the year ended March 31, 1950, and the net amount received in respect of duty was as follows:

Description (*a*)	Quantity of Duty Paid Oils Retained for Consumption	Net Receipts	Fully Rebateable Oils (*b*)
	Gallons	£	Gallons
Light oils			
Petroleum spirit—			
Motor spirit	1,375,443,410	51,585,532	—
Other spirit	53,067,866	1,990,045	—
Coal tar products—			
Benzole	17	1	—
Other Sorts	13,955	523	—
Turpentine	1,161,916	43,572	—
Heavy oils for mixing with light oils	—	—	—
Other hydrocarbon oils	364,667	13,978	—
Oils in composite articles	14,887	558	—
	1,430,066,718	53,634,209	—
Deduct net amount paid to Isle of Man (*c*)	—	62,053	—
TOTAL LIGHT OILS	1,430,066,718	53,572,156	—
Heavy oils for use as fuel in road vehicles (Duty paid at rate for light oils)	230,149,960	8,630,624	—
Other heavy oils (Duty paid at 1d. per gallon)			
Petroleum oil—			
Crude	755	3	5
Kerosine	338	2	440,173,489
Lubricating oil	143,626,664	598,458	4,866,574
Gas oil	(*d*) — 1,300	(*d*) — 5	397,470,279
Fuel oil	1,861,691	7,757	1,379,802,450
Other sorts	646,151	2,692	9,502,927
Coal tar products	773	3	101
Other oils	65,815	274	2,173,145
Oils in composite articles	156,565	612	113,483
Gases produced from imported heavy oils	—	—	—
TOTAL HEAVY OILS (other than road fuel)	146,357,452	609,796	2,234,102,453
TOTAL DUTIABLE OILS	1,806,574,130	62,812,576	—
Deduct allowance under Section 8 (4) of the Finance (No. 2) Act, 1945, in respect of indigenous hydrocarbon oils used as materials for process of chemical synthesis, etc.	—	263,585	—
	1,806,574,130	62, 548, 991	—

(*a*) The descriptions of oil correspond to those used in Customs documents but are not defined by statute.

(*b*) These quantities of oil fully rebated under Section 1 of the Finance Act, 1947, are quantities delivered out of official charge without payment of duty, whether or not subsequently exported.

(*c*) Difference between amounts collected in and allocated to the Isle of Man.

(*d*) Minus amount due to adjustment of account for previous year.

INJURY RATES IN THE U.S. OIL AND GAS INDUSTRY

In a report* recently issued by the U.S. Bureau of Mines it is shown that in 1948 the safety record of the oil and gas industry of the U.S. was better than in 1947. The injury-frequency rate of 14.46 disabling injuries per million man-hours compared with 14.94 in 1947, while the injury-severity rate of 1.46 days of disability per 1000 man-hours compared with 1.47.

Statistics in the report are based on returns from 1256 companies and the following details are extracted from the report in regard to 1948:

Department	*Men*	*Man-hours*	*Injuries* *Fatal*	*Non-fatal*
Exploration	8,598	19,024,622	5	373
Drilling	17,654	38,414,222	21	2,773
Production	76,705	160,386,185	28	2,931
Nat. Gasoline	17,178	35,067,499	9	368
Pipelines:				
Oil	30,493	64,238,750	11	836
Gas	16,420	33,832,585	3	500
Transport:				
Ocean	9,389	28,001,880	5	592
Inland	2,340	6,197,975	1	99
Refining	145,684	303,649,844	37	2,852
Marketing	122,781	268,216,458	25	2,935
Miscellaneous	38,210	82,942,641	9	923
Office	11,505	23,679,171	—	43
Not classified	4,296	9,075,876	2	122
Total 1948	501,253	1,072,727,708	156	15,356

* H.S.S. No. 389, prepared by J. H. Schuster and G. W. Crone, Accident Analysis Branch.

The R.A.F. Association. As part of the drive for increased membership of the R.A.F. Association, membership of which is open to all who served for not less than three months in any of H.M. Air Forces, Shell-Mex and B.P. Ltd. has presented a silver cup. This "Shell B.P. Trophy" is to be awarded to the area obtaining the highest percentage increase in any one year, and additional trophies are to be given for achievements at Branch level.

Kuwait Oil Co. Crude oil production for the month of June was 1,453,533 tons, making a total of 7,594,940 tons for the first half of 1950.

TANKER RENAMED

(An Esso photo.)

During a 24-hours turn round at Fawley recently, the 17000 tons tanker *Robert F. Hond* was renamed *Esso Newcastle*, in accordance with a new decision to name tankers of the Esso fleet after cities in the United Kingdom.

Built in 1933, this ship has for the past seventeen years mainly been engaged in carrying petroleum from Aruba and the Persian Gulf to U.K. and European ports. Throughout the war she traded on the trans-Atlantic convoy run, carrying petrol from the United States to Avonmouth. Her present Master, Captain H. W. Brice joined the Esso fleet in 1943.

MINING AND METALLURGY ABSTRACTS

The Institution of Mining and Metallurgy has just commenced publication of abstracts of world literature on economic geology and mining (excluding coal), mineral dressing, extraction metallurgy (excluding iron but including refining), and allied subjects. *I.M.M. Abstracts* will form part of the Bulletin of the Institution and the first issue appeared in the July issue. Subscription to the Bulletin is £3 per annum and inquiries should be addressed to the Institution at Salisbury House, Finsbury Circus, London, E.C.2.

AROUND THE BRANCHES

FAWLEY, LONDON, NORTHERN, SCOTTISH, SOUTH WALES, STANLOW, TRINIDAD

Stanlow Branch

On July 28, 1950, about thirty members of the Stanlow branch spent a very pleasant afternoon as guests of Petrochemicals Ltd., at Partington, Cheshire.

Before the party visited the plant Dr H. K. Whalley outlined the history of the Catarole process for producing aromatic hydrocarbons and olefinic gases simultaneously from a petroleum naphtha fraction. An almost unlimited number of products can be derived from both the gaseous and liquid phases and some of these products are obtained in large quantities in very pure forms.

The cracking plant is situated at one end of the site and consists of a number of small identical units. This allows the maximum flexibility and enables a unit to be used for experimental runs when desired. All the raw material passes through the cracking plant. The cracked products are cooled and the aromatic liquids are thus separated from the olefinic gases. Further processing of the gases takes place in a section of the works which is separated from the part dealing with the liquids by a central area containing the workshops, stores and other services. The gases are fractionated by low-temperature distillation under pressure. The liquids are separated by atmospheric and vacuum distillation and considerable use is made of azeotropic distillation. Chemical treatment of the products is carried out as required.

Special attention has been given to the location of the services and a very high degree of standardization has been achieved in instrumentation and fittings. A routine testing laboratory is conveniently situated and a development laboratory located on the site enables any plant problems to be dealt with speedily. When a new plant is nearing completion the prospective operators follow the final stages of erection and carry out the testing of the equipment so that they are already familiar with the unit when it starts up.

All the basic work for the building of Petrochemicals Ltd., was done in Great Britain by Petrocarbon Ltd., a point of some interest in an industry which has been, and for that matter still is, to a large extent dependent on American influence.

It is remarkable that in so short a time (construction started in October 1946) many of the plants have the appearance of being well established and of having passed through their teething troubles.

After visiting the plant the party were entertained to tea, during which members of the staff of Petrochemicals Ltd. mingled freely among and had interesting informal chats with the visitors.

A vote of thanks was proposed on behalf of the branch by A. D. Makower and the party returned to Stanlow satisfied that they had widened their knowledge of petroleum in addition to having spent a most enjoyable afternoon.

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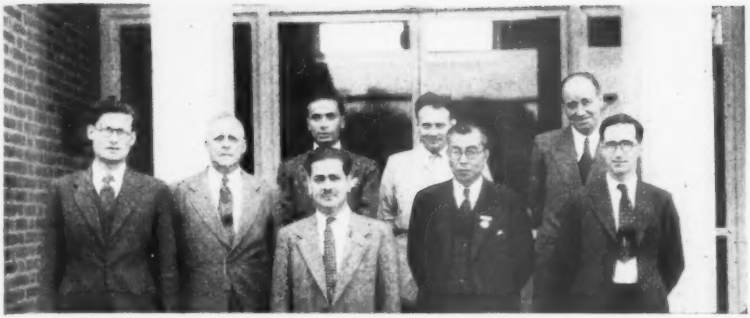
A.S.T.M. MEETINGS

The next meeting of Committee D-2 on Petroleum Products and Lubricants of the American Society for Testing Materials is being held at Detroit, Michigan, October 8-11, 1950.

The 1951 Annual Meeting of the A.S.T.M. is to be held in Atlantic City, New Jersey, June 18-22, 1951, and the Spring Meeting and Committee Week is March 5-9, 1951, at Cincinnati, Ohio.



Delegates to the recent World Power Conference were entertained by the Anglo-Iranian Oil Company at Sunbury Research Station, where the visitors saw the new products and inspection laboratories. The party was conducted by Dr K. G. Brummage and Mr L. B. Witten.

C.B.M.P.E. ANNUAL GENERAL MEETING

At the A.G.M. of the Council of British Manufacturers of Petroleum Equipment held on June 22, Mr E. F. E. Howard, the Chairman, said that the industry was faced with the problem of finding capacity to meet the requirements of the U.S. oil companies purchasing in the sterling area, as the result of recent oil agreements. He stressed that this opened up several new considerations. They were being handed an opportunity which they would only grasp if they were quite certain that the material they were producing was quite right and satisfactory to the U.S. user, who was going to be even more critical of materials coming from Britain than the British-controlled oil companies were.

The Chairman also announced that three "Hints on Travel" booklets, on North America, the Caribbean and the Middle East, were sufficiently advanced for him to be able to ask members for advance orders.

The meeting passed a resolution of appreciation of the share in the standardization work over the last six years taken by the oil company engineers, through the Oil Companies Materials Committee.

"INSULATING OILS"

An amount of diverse information on insulating oils for transformer and switch gear, based on long experience of their manufacture, supply, and operation, has been collected in an attractive book of more than 100 pages, produced by Shell.

The chapter on the service performance of transformer oils is divided into "operating conditions" and "transformer design in relation to oil" and the chapter on the performance of switchgear oil is treated in a similar manner. Other chapters include the manufacture of insulating oil, specifications, installation, and operation of transformers in relation to oil, and sampling.

The book is illustrated by a number of photographs and coloured diagrams.

COPPER FITTINGS

At a recent meeting it was decided to form an association of Copper Fittings Manufacturers. A drafting committee has been appointed and reports will be sent to interested manufacturers. Temporary secretary is E. Chiffey, Kay & Co. (Engineers) Ltd., Blackhorse Street, Bolton, Lancs.

WORLD OIL POSITION

The following is extracted from the 1949 Report of the N.V. Koninklijke Nederlandsche Petroleum Mij (Royal Dutch Petroleum Co.):

During the past year the availability of crude oil grew more rapidly than effective demand and it is understandable therefore that production should show a levelling off as compared with the previous year.

The production of the United States in 1949 was lower than in 1948; on the other hand, the Near East and the Middle East areas together yielded a record production in the year under review, slightly exceeding even that of Venezuela. The relative share of the United States in world production has therefore slightly decreased, although that country is still by far the largest oil producer. It will be seen that both Kuwait and British Borneo have moved up one place in the list of producing countries.

The world demand for petroleum products, which has increased considerably since the war, has been met for the present by the growth in crude oil production and by the extension of refinery capacity during the post-war years.

The potential world requirements of petroleum products are considerably higher than the present world consumption, so that there is still scope for an appreciable expansion in consumption in the future. Difficulties of an economic, financial or political nature in various countries or in their trade with one another, however, still restrict this growth.

Significant developments have taken place in the United States, which, as is well known, consumes some 60 per cent of the world's petroleum products. The year turned with a danger of excessive stocks of fuel oils accumulating there, as a result of the exceptionally mild weather of the first part of the winter. The return to more normal climatic conditions caused a rapid correction of this position, and it is interesting to note that at the end of April, 1950, stocks of fuel oil in great producing and consuming centres of the Gulf of Mexico and the Eastern United States were the lowest for many years.

A significant change has also taken place in the gasoline position there. Only a few weeks ago, some fears were expressed regarding the high level of gasoline stocks, but the increase in consumption has been so rapid that the position has adjusted itself.

WORLD PRODUCTION OF CRUDE OIL AND NATURAL GASOLINE

Country	*Millions of barrels* 1949	1948
U.S.A.	1,996.5	2,166.9
Venezuela	482.9	490.6
U.S.S.R. (incl. Sakhalin)*	251.9	222.5
Persia	204.8	190.4
Saudi Arabia	174.0	142.9
Kuwait	89.9	46.5
Mexico	63.2	60.9
Indonesia	42.2	31.8
Roumania*	32.0	30.4
Iraq	31.4	26.4
Colombia	30.4	24.3
British Borneo	25.1	20.1
The Argentine	22.2	23.2
Canada	21.7	12.4
Trinidad	20.9	20.4
Egypt	15.9	13.2
Peru	15.8	15.2
Bahrein	11.0	10.9
Austria*	6.0	6.3
Germany	6.0	4.5
The Netherlands	4.3	3.4
Hungary*	3.8	3.6
Ecuador*	2.7	2.7
India	2.0	1.9
New Guinea	1.7	0.1
Others	8.6	7.4
Total	3,566.9	3,578.9

* Estimated

According to the specific gravity of the crude oil, one metric ton varies from 6.7 to 7.5 barrels.

Paraspred, a spreading agent for paraffin and microcrystalline waxes is now being produced by Glyco Products Co. Inc, 26 Court Street, Brooklyn, N.2., N.Y., from whom samples are available.

FORTHCOMING MEETINGS

INSTITUTE MEETINGS

Manufacture of Furnace Carbon Black from Liquid Hydrocarbons at Ellesmere Port. L. W. Cabot, J. W. Edminster and C. A. Stokes. At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), September 13.

The Role of Petroleum in European Recovery. Vernon Smith. At 26 Portland Place, London, W.1, 5.30 p.m. (*tea* 5 *p.m.*), October 11.

Stanlow Branch

Planning a Large Scale Crude Oil Development in a Desert Region. C. A. P. Southwell. At Grosvenor Hotel, Chester, 7.15 p.m. October 19.

OTHER SOCIETIES

The High Speed Light Weight Diesel Engine. Com'r (E) J. H. D. Middleton. The Institute of Marine Engineers, London, 5.30 p.m. October 13.

Flow Patterns in Furnaces. J. H. Chesters. Society of Chemical Industry, Chemical Engineering Groups. At Burlington House, London, W.1., 5.30 p.m. October 24.

Construction of Oil Tankers. H. Armstrong. Institute of Marine Engineers, at Constantine Technical College, Middlesborough, 7.30 p.m., November 6.

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BOILER CORROSION

The paper entitled "Boiler Corrosion and Boiler Feed Treatment" by H. Hillier, originally read before the Institute of Marine Engineers in November, 1949, has been reprinted, including discussion and communications, as a two-page pamphlet.

Messrs G. & J. Weir, Ltd., Cathcart, Glasgow, S.4, state that copies are available on application to their publicity manager.

CHEMICAL INDUSTRY CHART

A chart setting out the principal products of the British chemical industry is available, price 1s. 0d. post free, from the Association of British Chemical Manufacturers, 106 Piccadilly, London, W.1. This chart originally formed part of the 1949 *Report on the Chemical Industry* which was prepared by the Association.

★ ★ ★

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CHEMIST, preferably under 35, required by a major oil company for its London laboratory. Good education and an Honours B.Sc. degree or A.R.I.C. are essential qualifications. Applicants must already have some knowledge of the development and manufacture of soluble oil compositions for use in the textile, leather or metal processing industries, and ultimately be capable of tackling on the spot the varied problems that may arise in their application. The position is one of responsibility and previous industrial experience is necessary. Salary will be commensurate with qualifications and experience; conditions of employment include pension and sickness benefit schemes. The company is expanding and the opportunities for progress will be excellent for a young, energetic man who can apply his knowledge widely. Applicants should write giving full particulars to Box No. A.11-1055.

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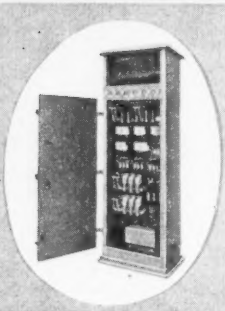

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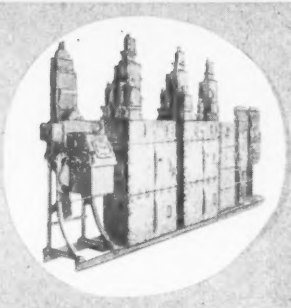

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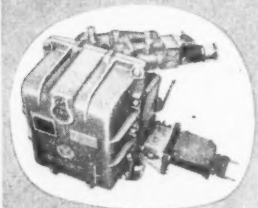

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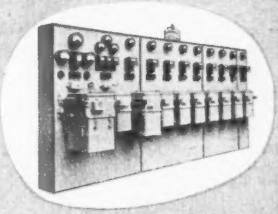

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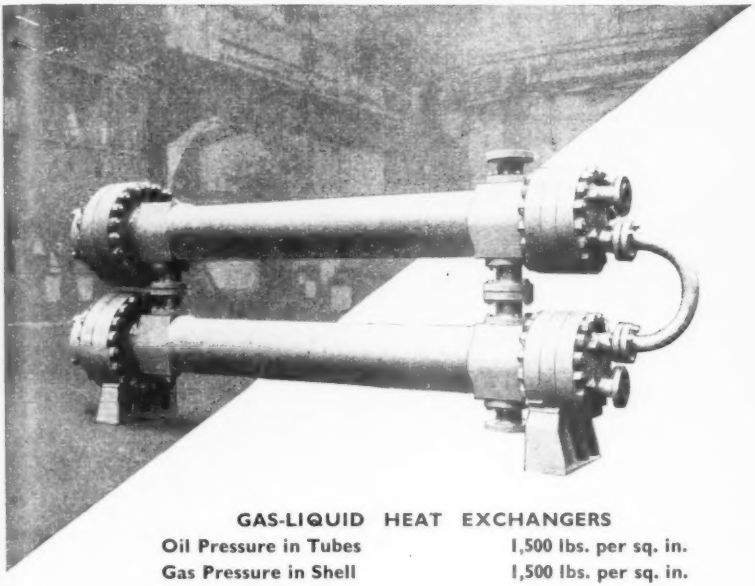

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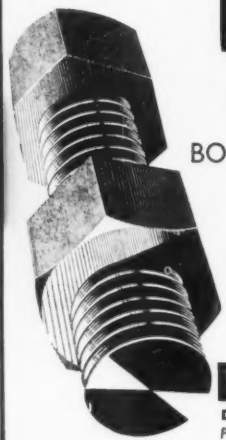

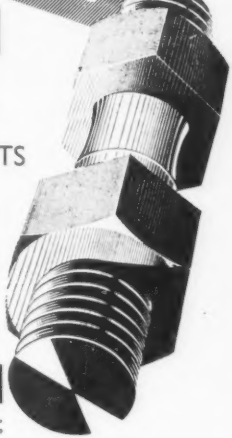

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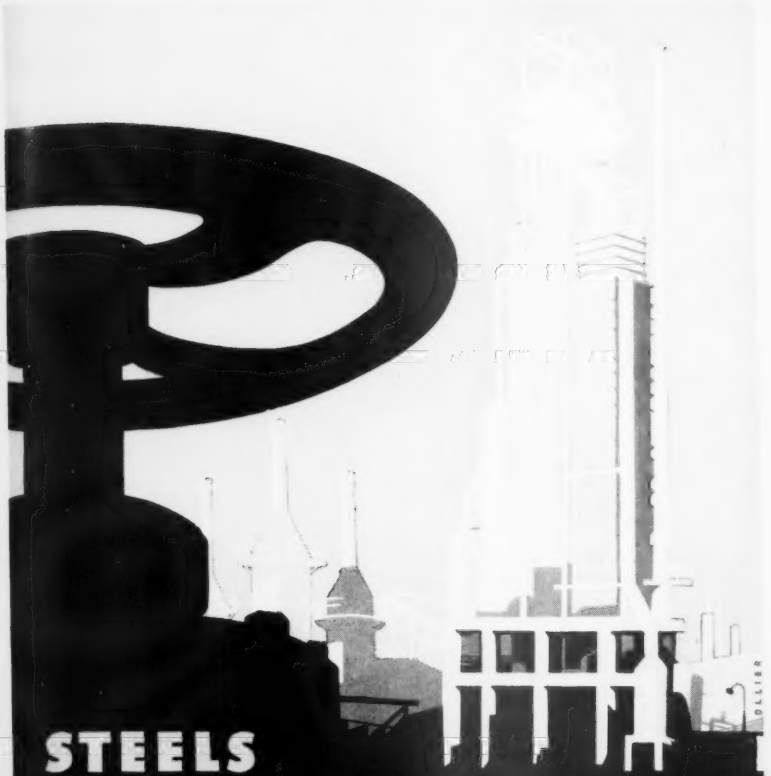

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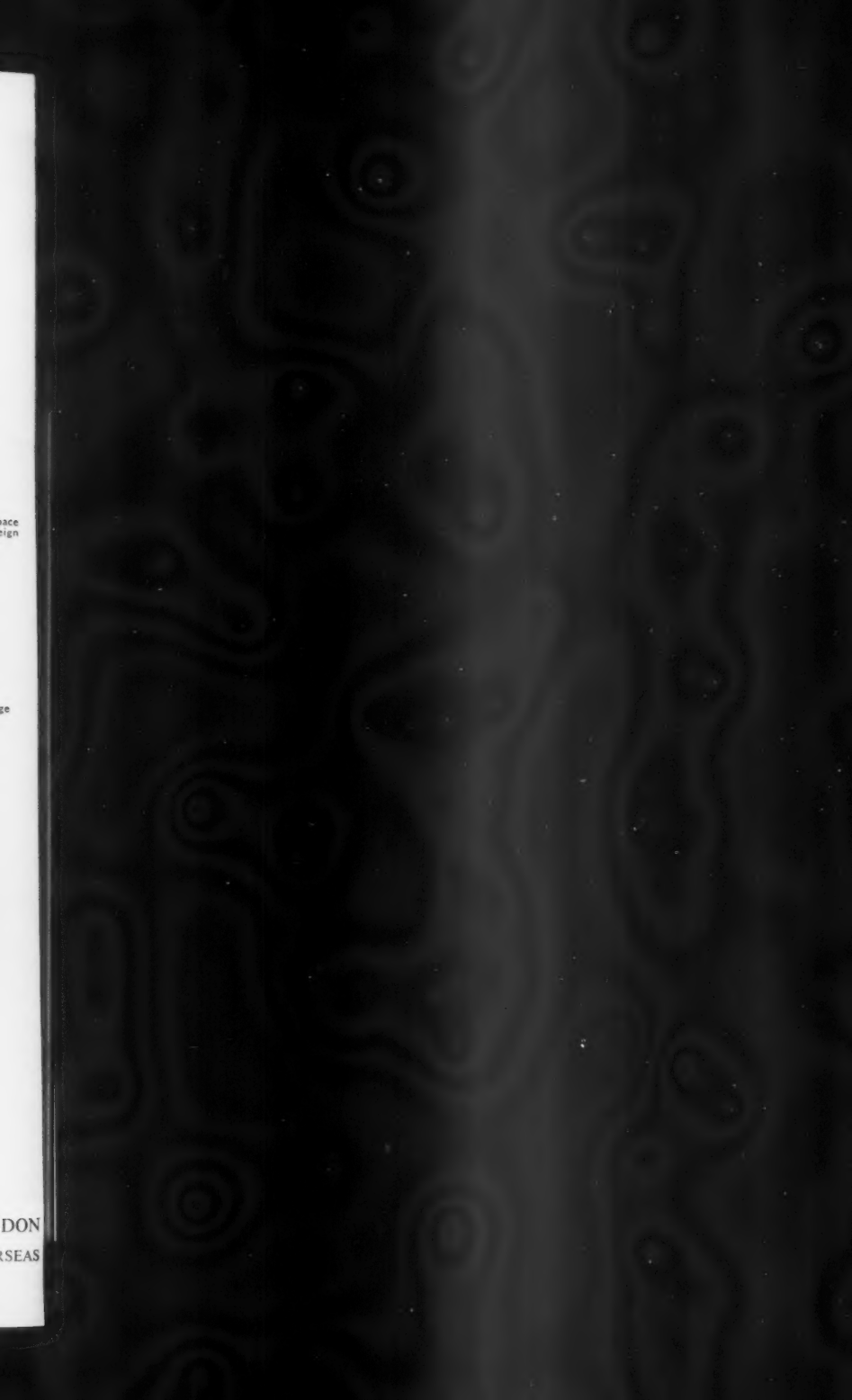
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